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ABSTRACT

This study explores what cooperative learning activities in an undergraduate chemistry course meant to the students. Cooperative learning activities were used throughout the course with one class session per week being entirely devoted to such activities. An analysis of field notes and a questionnaire completed by the students yielded three findings from the perspective of the students. First, these cooperative learning activities created a learning community characterized by intellectual challenge, support, and encouragement which promoted a warmer classroom climate. Second, the interaction between students facilitated the development of interpersonal skills and communication skills which lead to more meaningful learning. Third, these activities gave the students tools for learning the material. Contains 31 references. (Author/JRH)

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Student Perspectives of Cooperative Learning Activities

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Abstract

The purpose of this study is to understand what cooperative learning activities in an undergraduate chemistry course meant to the students. Cooperative learning activities were used throughout the course with one class session per week being entirely devoted to such activities. An analysis of field notes and a questionnaire completed by the students yielded three findings from the perspective of the students. First, these cooperative learning activities create a learning community characterized by intellectual challenge, support, and encouragement which produces a warmer classroom climate. Second, the interaction between students facilitates the development of interpersonal skills and communication skills which leads to more meaningful learning. Third, these activities give the students tools for learning the material. These findings allow us to add breadth and depth to our understanding of positive cooperative learning outcomes such as achievement, persistence, and retention.

Introduction

Cooperative learning has emerged as a "new" approach to college classroom instruction. It appears that the disparity between what research indicates about effective teaching and practices in college science classrooms may be decreasing. In the discipline of Chemistry, cooperative learning has been implemented in general chemistry lecture and laboratory (Cooper, 1995; Nakhleh, Lowrey, & Mitchell, 1996), organic chemistry (Cooke, R. J., 1995; Coppola, Ege, & Lawton, 1997), analytical chemistry (Walters & Voress, 1991), and physical chemistry (Towns & Grant, 1996). Cooperative learning has also been implemented in other science disciplines such as Physics (Heller, Keith, & Anderson, 1992), Biology (Miller, 1996; Posner & Markstein, 1994), Anatomy and Physiology (Trautwein, Racke, & Hillman, 1997), and Engineering (Felder, 1996; Felder & Brent, 1994; Terwilliger & Groccia, 1996).

Cooperative learning has been touted as a method of ensuring that students actively engage in the course material and create their own knowledge as opposed to passively accepting knowledge from the instructor. Roger T. Johnson and David W. Johnson have written numerous articles and books on cooperative learning in which they have identified five essential components of cooperative learning: 1) positive interdependence among students seeking a common goal, 2) face to face interaction among students, 3) individual and group accountability, 4) use of interpersonal and small group skills, and 5) group processing skills (Johnson and Johnson, 1989a; Johnson and Johnson, 1989b; Johnson, Johnson, & Holubec, 1993; Johnson, Johnson, & Smith, 1991). Cooperative learning activities are consistent with the idea that students must actively process information in order to learn it in a meaningful way (Edmondson & Novak, 1993). Cooperative learning activities can create an environment where students actively engage in the material by sharing insights and ideas, giving feedback, and teaching each other.

Research studies carried out in a wide range of settings--elementary, secondary, post-secondary, and training schools--and across content areas have shown that cooperative learning leads to positive outcomes such as higher achievement, increased positive attitudes toward the subject area studied, higher self-esteem, greater acceptance of differences among peers, greater persistence and retention, and enhanced conceptual development (Cohen, 1994; Qin, Johnson, & Johnson, 1995). These studies have arrived at these conclusions using primarily quantitative means--looking for quantitative differences between students in cooperative classrooms versus competitive and or individualistic classrooms. To date, few studies have used qualitative methods to help us understand the efficacy of cooperative learning. In regard to the experience of cooperative learning, the voices of the students themselves have been silent. Adding the voices of the students to what is known about cooperative learning activities would contextualize how and why cooperative learning produces higher achievement, greater persistence, retention, and other positive outcomes.

The goal of the present study is to learn what cooperative learning activities meant to the students involved in them. Thus, the following research question guided the study: *What did the cooperative learning activities mean to the students involved?*

Methodology

In this section the theoretical framework is presented. A description of the researchers, the participants, and the site are given to help the reader understand the role and perspective of the researchers, and the setting in which they operated. Finally, data collection and analysis procedures are clarified.

Theoretical Framework

To gather information about what the cooperative learning activities meant to the students involved, we used a hermeneutic approach. Hermeneutics researchers use qualitative methods to construct meaning on the basis of their interpretations of the data which was provided by the participants in the study (Patton, 1990). We also approached this project with a strong belief in the constructivist theory of knowledge (Lincoln & Guba, 1985; Schwandt, 1994; von Glasersfeld, 1991). In order to engage in meaningful scientific learning as opposed to simply memorizing material, students must connect new knowledge to their existing knowledge in ways that make sense to them (Edmondson & Novak, 1993). Thus this cooperative learning project not only contains research questions that are interesting to us, but it is centered upon a theory of building knowledge in which we strongly believe.

Description of the Researchers, the Participants, and the Site

The credibility and character of qualitative research depends upon the credibility, bias, and inclinations of the researchers involved. The researchers decide what questions to ask, what approach to use, how the analysis will be executed, and ultimately what findings will be synthesized from the data. Thus, a description of the researchers is appropriate and necessary to understand the findings which emerge from this study.

The second author carried out this research project in her own classroom. She has experience teaching chemistry in secondary and post-secondary settings. Cooperative learning methods have been a component of her classroom since the fall of 1994. Her research experience includes both qualitative and quantitative educational projects, and basic scientific research. The first author served as a research assistant for this project. Her role is explained in the data analysis section. Both researchers believe that knowledge is constructed in the mind of the learner, although the first author's belief is based more on experience than reading the educational literature.

The participants were undergraduate students at a large midwestern university in the United States. The class was composed of 19 students - four women and 15 men. Eighteen of the students were science majors and one was a pre-service high school chemistry teacher. One student was a minority and all of the students spoke English as a first language.

The course was an undergraduate level thermodynamics course. It was tailored for chemistry majors and covered the following topics: Thermodynamics, Chemical Equilibrium, Solutions, and Electrochemistry. Students attended three lectures a week. As the semester progressed, the class became oriented around 15-30 minute lecture segments and 5-10 minute small group activities. Students attended one weekly 50 minute "problem solving session" (PSS), which was entirely devoted to cooperative learning activities. The laboratory component of the course consisted of one weekly three hour lab conducted in groups of two to three students.

Data Collection

To understand what the cooperative learning activities meant to the students, we directed the data collection at capturing the students perceptions of cooperative learning activities. Field notes and the student's responses to a questionnaire provided data upon which would we based conclusions regarding our guiding question. The primary researcher recorded classroom observations and informal student-professor conversations outside of class as field notes in order to describe events which took place during cooperative learning activities. At the end of the semester a questionnaire was administered to all students.

The questionnaire was administered following a short debriefing session with the students. The questionnaire contained questions of a general nature about the course and questions which centered on PSS. For example, we asked "What were your perceptions of the course?" as well as "What are the strengths of the PSS's?" By asking both types of questions we gathered data concerning what the cooperative learning activities meant to the students.

Data Analysis

We analyzed the questionnaire using an open coding scheme (Strauss & Corbin, 1990). First, we created a transcript that grouped data by question. Reading the transcript question by question each researcher looked for themes or patterns in the responses. For example, the students were asked to write about the strengths of the PSS's. Some of the students responded that the PSS's helped them *develop problem solving skills* and *different perspectives on solving problems*. These themes were given codes which were used to identify these themes within each student's response. We met as a team to discuss the rationale behind our individual coding schemes and subsequently developed a joint coding scheme. We then re-analyzed the data individually, and developed categories and properties which naturally emerged from the data. As a team we discussed our individual categories and their properties. Field notes were used to support or refute these emerging categories and properties. The product of our discussions were three categories which helped us formulate our findings. By moving between the data, our research question, and our individual perspectives we were able to triangulate our findings, adding reliability and validity to our study.

Findings

Three overall findings emerge from our analysis of the questionnaire and field notes. These findings focus on how cooperative learning warmed the classroom climate, how cooperative learning facilitated the development of interpersonal and communication, and how cooperative learning was used as a tool for learning by the students. We discuss these findings then present the categories and properties to support them.

First, we found that cooperative learning activities create an environment characterized by intellectual challenge, support, and encouragement which produces a warmer classroom climate. Students develop friendships and build trust among groupmates which allows them to encourage, question, and support each other. Carl's voice speaks for many students in the course:

> "I feel like the group work and just the friendships in the class in general made for a very conducive to learning atmosphere. When I transferred here . . . I didn't know anyone and I found myself not asking questions about topics I didn't understand or just needed a little clarification; once I began to know my peers, I was more comfortable asking questions and just being in the class in general, and being comfortable allows you to learn more from the class."

As the students sense that they can rely on each other and trust each other a feeling of community grows. It is this sense of community which promotes learning and achievement.

Second, the interactions between students provides them with the opportunity to develop the necessary interpersonal skills and communication skills which lead to a more meaningful understanding of the material. The students had the opportunity to share different perspectives on solving problems and teach their peers. As Larry writes: "The communication between the group members was invaluable when it came to different ways of solving a problem." Through discourse generated during cooperative learning activities the students acquire different perspectives on solving problems and develop a more robust set of problems solving skills. In addition, students build the "professional skills", or interpersonal competence, they will need to succeed and flourish in the workplace.

Third, the cooperative learning activities give students tools for learning the material. The PSS's proved an incentive to study the material in a timely fashion and help students develop relationships between concepts. As Sally writes: "The in-class work and the PSS were very helpful in keeping the material fresh in my mind and they also help to see relationships among everything we've studied." Students found that the PSS's helped them draw connections between concepts and applications, prepared them for examinations, and provided review and repetition over important information.

The remainder of the findings section is used to define categories and properties derived from the questionnaire and field notes. By discussing the categories and properties we generated, supported by excerpts from the surveys and field notes, we will show how cooperative learning leads to a warmer classroom climate, improves interpersonal and communication skills, and provides students with a tool for learning and integrating the material.

Conclusions and Implications

These findings allow us to add breadth and depth to our understanding of positive cooperative learning outcomes such as achievement gains and increased persistence and retention. Drawing multi-directional relationships between our findings allows us to add the dimension of context to *how* and *why* cooperative learning promotes achievement and increases persistence and retention.

These findings contextualize our understanding of why cooperative learning produces higher achievement gains compared to competitive or individualistic situations. Cooperative learning produces a feeling of community in the classroom and fosters a warmer classroom climate which promotes learning and achievement. This warmer climate expresses itself in the students forming friendships and challenging and encouraging each other to truly understand the material. By asking questions, listening, and exploring each other's reasoning students gain rapid feedback on what they know or do not know. This feedback hinges on the students using effective interpersonal skills and communication skills. They must listen to each other with respect and critically evaluate each other's contributions. They must strive to understand different ways of explaining the material and different perspectives on solving problems. It has been observed that as students become more adept at articulating what they know, their level of engagement increases (Richmond and Striley, 1996). From these actions students develop a framework for understanding the material which integrates concepts, applications, and problem solving skills. Each of these characteristics--the warmer classroom climate, the development of interpersonal competence, and the diversification of problem solving abilities--promotes higher achievement.

Our findings also add the dimension of context to the observed increase in persistence and retention within groups of individuals which become linked through a cooperative component. We find that in our classroom where cooperative activities are an integral part of the curriculum, a feeling of community and a warmer classroom climate evolves as the students build friendships and develop trust. If the students believe that they can rely on one another, then they can encourage, question, and support each other. Their tenacity and willingness to endure frustration increases because they believe that they will eventually succeed. Since they are committed to each

other they want every group member to be a part of this success. There are enough rewards for every student to achieve at a high level and to be recognized for that success. Thus, persistence and retention hinge upon the students building a feeling of community.

These findings point towards cooperative learning as a method of helping students learn concepts and narrowing the gap between conceptual and algorithmic understanding of chemical phenomena (Nakhleh, Mitchell, & Lowrey, 1996). Cooperative learning encourages interactions among students. Discourse which involves the exchange of ideas, insights, and representations is needed to build an understanding from more than one perspective (Towns & Grant, 1996).

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